1,188,863

PATENT SPECIFICATION 1,188,863

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in or relating to Motor Vehicle Differential Gearboxes.

We, HERWAYTHORN S.A., a French body corporate of 48, rue de Malte, Paris 11, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to motor vehicle differential gearboxes.

For some time past, motor vehicles have been built with driving axles for transmission of various types, in which a pinion keyed onto the end of the transmission shaft and the rim of the differential cage have a hypoid system of teeth. In other words, the main axis of the differential and of the toothed rim, on the one hand, and the axis of the transmission shaft and of the pinion, on the other, are not concurrent. In general, the pinion is installed below the horizontal plane passing through the main axis of the axle and of the wheels.

It is also known for the end part of the transmission shaft, adjacent the pinion, to be guided in the differential gearcase by the aid of a first and a second bearing, at a certain distance apart. These latter may be of any suitable type; at the present time they almost exclusively consist of roller bearings capable of standing up to high radial and axial loads. It is generally difficult to lubricate these bearings correctly, particularly the one farthest from the pinion. Numerous solutions have been suggested for this problem. A simple solution, known in particular through US. Pat. RE 20149 is that in which the gearcase contains a pan situated in the plane of the rim of the differential. This pan is moulded as an integral part of the gearcase; it receives the oil projected by the differential rim. In the prolongation of the said pan a channel is provided to guide the oil to the bearings. The oil then returns to the base of the gearcase, which surrounds the differential.

All the known means of lubrication, including that described in the aforementioned United States of America patent, suffer from a serious drawback. Their design is such that they can only function normally when the axle on which they are mounted is itself in the position which it is normally required to occupy. In other words, if the axle is of the type in which the pinion, in the operating position, is situated below the horizontal plane passing through the main axis of the axle, the assembly of this axle cannot be reversed, which means that it cannot be placed in a position such that the pinion is situated above the said horizontal plane, for under these circumstances the lubrication of the bearings would be very defective, if any lubrication took place at all. The bearing would then only last for a very limited period.

Now although the driving axles are generally installed in such a way that the pinion which acts on the rim of the differential with a hypoid system of teeth is situated below the horizontal plane passing through the main axis of the axle, it is often found desirable to place this pinion above the said horizontal plane.

Under the present circumstances, either two different kinds of axle are used, of which the position can never be modified, or only one kind of axle is adopted, with a lower pinion, of which the use sometimes complicates the transmission, owing to the fact that the position selected for this axle is necessarily invariable.

Accordingly to the present invention there is provided a differential gearbox for a motor vehicle, comprising a case, a differential cage within the case and including a toothed rim, and a transmission shaft mounted in two

bearings in the case and carrying a driving pinion which engages said toothed rim, one of said bearings lying adjacent said pinion and the other being spaced from said one bearing, wherein the wall of the case defines two channels opening independently of each other into the case interior, the channels being separated by a common partition and each communicating with a hollowed-out portion of the case situated between the two bearings.

A constructional embodiment of the invention will now be described by way of an example with reference to the attached accompanying drawings, wherein:—

Figure 1 is a partial view, from above, in broken section, of a driving axle in accordance with the invention;

Figure 2 is a sectional diagram, along the line II—II of Figure 3, of the gearcase cast in one piece for the axle of Figure 1, without the mechanical devices usually contained in the said gearcase;

Figure 3 is a sectional view, along the line III—III of the gearcase shown in Figure 2;

Figure 4 is a sectional view, along the line IV—IV of Figure 3; and

Figure 5 is a sectional view, along the line V—V of Figure 2.

The main components, already known in themselves and comprising a driving axle of a motor vehicle, will now be briefly enumerated, by reference to Figure 1.

The axle shown is of the type in which the pinion acting on the rim of the differential cage has a hypoid system of teeth. In other words, the main axis 1 of the axle does not contact the main axis 2 of the transmission shaft 3. Contrary to the impression given by Figure 1, which is a "broken sectional diagram", the horizontal plane containing the main axis 1 does not contain the main axis 2. This latter can pass above or below the said horizontal plane. Figure 2 provides an idea of the displacement between the two axes 1 and 2 of the axle, on the one hand, and of the transmission shaft, on the other.

The main axis 1 of the axle is also the main axis of a conventional differential, designated by the general reference number "4", and comprising a toothed rim 5. This latter engages a driving pinion 6 keyed on to the end of the transmission shaft 3.

The entire system is enclosed in a gearcase 7, which is provided with a cover 8. The end part of the transmission shaft 3 is guided in the gearcase 7 by means of two roller bearings, one of these, 9, being adjacent the pinion 6 which acts on the rim 5, and the other, 10 being spaced from the bearing 9.

These bearings 9 and 10 consist, generally speaking of low-friction bearings of the type suitable for the conditions of operation contemplated.

As usual, the gearcase 7 contains a certain volume of oil, in which the toothed rim 5 is partly submerged.

Substantially in the plane of rotation of the toothed rim 5, the actual wall of the gearcase 7 delimits a space subdivided into two channels 12 and 13 by one common partition 14. The internal partition 14 is cast in one piece with the gearcase unit.

Figures 2—5 show the gearcase alone, as a rough casting, without the cover 8 and without the internal mechanical devices.

It may be seen from Figure 5 that the volume of the channels is clearly delimited externally by the actual wall of the gearcase, which in the place in question has a kind of enlargement. The channels 12 and 13 extend along the space of which the purpose is to accommodate the transmission shaft 3.

The common partition 14 separates the channels 12 and 13 from each other, and these open separately (Figures 2, 3 and 4) inside the gearcase, communication being provided between their opposite end (Figure 1), after an interruption of the partition 14, and a hollowed-out part 11, of a relatively small volume, situated between the two bearings 9 and 10. It may be seen that the cross-section of each of the channels 12 and 13, at the place where it opens into the gearcase, is greater than its cross section at the place where it combines with the hollowed-out portion 11.

The opening of each channel in the gearcase extends over a quarter-circle, as clearly shown in Figure 3, the partition 14 being on a level with the main axis 2 of the shaft 3. To be more specific, the partition 14 and the axis 2 are substantially situated on one and the same plane, perpendicular to the vertical plane containing the axis 2 when the gearcase is in its position for operation.

Furthermore (see Figure 4), the partition 14 is provided, on its part 14*a*, exposed inside the gearcase 7, with edges or lips, of comparatively large dimensions and extending, at 15 and 16, on both sides of the opposite faces of this partition 14. This system ensures a general symmetry for the channels 12 and 13, for their openings in the gearcase, for the partition 14 and for the lips 15 and 16, in respect of a plane passing through the axis 2 of the shaft 3 and perpendicular to the vertical plane containing the axis 2 when the gearcase is in its position for operation.

The toothed rim 5 may be regarded as an element submerged in the oil of the gearcase and rotatable around the main axis 1 of the differential. During operation this element, which in the present example is the rim itself, projects oil through the inlet of the channels 12 and 13. Owing to the existence

of the partition 14 and of the edges or lips 15 and 16, that one of the two channels which is situated above the other conveys the oil in the direction of the hollowed-out part 11 and the bearings 9 and 10, while the channel below the other guides this oil, on its return, to the interior of the gearcase. As the cross-section at the inlet of each channel is greater than in the vicinity of the bearings, a constriction occurs in the vicinity of these latter, reliably ensuring their lubrication. Similarly, each edge, 15 or 16, of the upper channel, 12 or 13, forces the oil towards the bearings instead of allowing it to fall direct into the gearcase.

The fact is that in the embodiment shown in Figure 1, the second bearing 10, farther from the interior of the gearcase, is in more direct communication with the hollowed-out part 11, as may be seen from Figure 1, than the bearing 3, which can receive direct the oil projected by the rim 5. An internal partition situated in the hollowed-out part, in the vicinity of the bearing 9, causes the oil to move to a greater extent towards the bearing 10.

It will be noted that the oil circulation which comes about in the channels 12 and 13 is independent of the position of the gearcase 7. When the latter is arranged as shown in Figure 2, or in the reverse direction, i.e. if the diagram is reversed, with the position for the transmission shaft 3 higher up than the axis 1 of the axle, the same result is obtained. The fact is that the oil projected by the rim 5 into the orifices 12 and 13 invariably creates a flow of oil proceeding through the upper channel towards the bearings and returning through the lower channel to the gearcase.

Due to the symmetry of the channels, in accordance with the invention, an axle such as that described can be mounted either in one direction or in the other, without distinction, and without any conversion operations, and with the same simple and effective lubricating action for the bearings, particularly of the second bearing of the transmission shaft.

It is obvious that the channels could be installed in a different position and that use could be made, for the projection of the oil thereto, of a rotor rotating with one of the parts of the differential or with a part, such as an axle, driven by the differential. However, the use of the differential rim itself is more advantageous.

It is also obvious that a different general form could be adopted for the hollowed-out part 11 and the channels 12 and 13. Although the above description relates to an axle with a pinion and rim with a hypoid system of teeth, it is possible to apply the invention to a transmission axle of a completely different type, if it is considered advantageous for this axle to be capable of being mounted in either one direction or the other according to circumstances.

WHAT WE CLAIM IS:—

1. A differential gearbox for a motor vehicle, comprising a case, a differential cage within the case and including a toothed rim, and a transmission shaft mounted in two bearings in the case and carrying a driving pinion which engages said toothed rim, one of said bearings lying adjacent said pinion and the other being spaced from said one bearing, wherein the wall of the case defines two channels opening independently of each other into the case interior, the channels being separated by a common partition and each communicating with a hollowed-out portion of the case situated between the two bearings.

2. A gearbox as claimed in claim 1, wherein the partition is provided, at its end adjacent the openings of the channels in the interior of the case, with two edges or lips extending on both sides of the said partition.

3. A gearbox as claimed in claim 2, wherein the common partition and the lips of the said partition are symmetrical in relation to a plane passing through the axis of the transmission shaft and perpendicular to the vertical plane of symmetry of the said shaft, when the gearbox is in its position for use.

4. A gearbox as claimed in claim 1, 2 or 3, wherein the common partition extends longitudinally in a plane substantially coinciding with the plane which passes through the axis of the transmission shaft and which is perpendicular to the vertical plane of the said transmission shaft, when the gearbox is in its position for use.

5. A gearbox as claimed in any one of claims 1 to 4, wherein the openings of the channels in the interior of the case are symmetrical in relation to a plane passing through the axis of the transmission shaft and perpendicular to the vertical plane of symmetry of the said shaft.

6. A gearbox as claimed in any one of the preceding claims, wherein the openings of the channels in the interior of the case each have an arcuate shape extending substantially over a quarter-circle.

7. A gearbox as claimed in any one of the preceding claims, wherein an internal partition is situated in the hollowed-out portion in the vicinity of the bearing adjacent the pinion and arranged to cause the

oil to move to a greater extent towards the bearing remote from the pinion.

8. A motor vehicle differential gearbox, substantially as described with reference to and as illustrated in the accompanying drawings.

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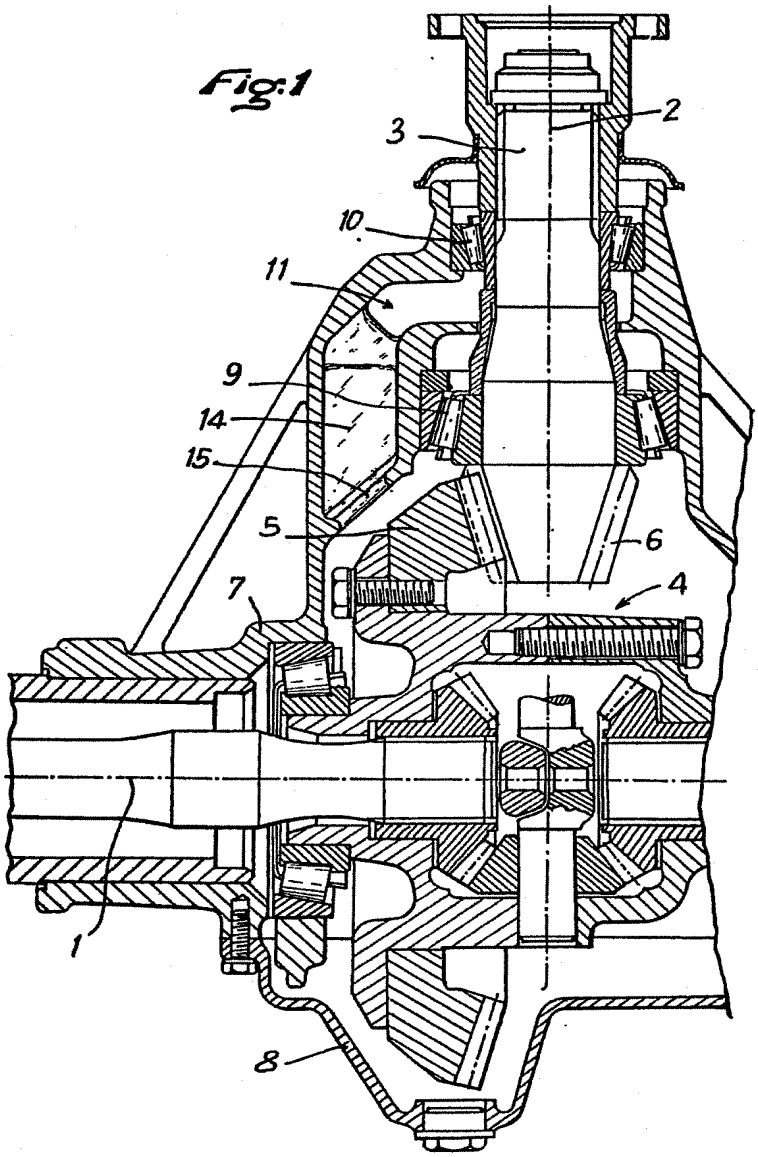
1188863 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig:1



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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

Fig: 2

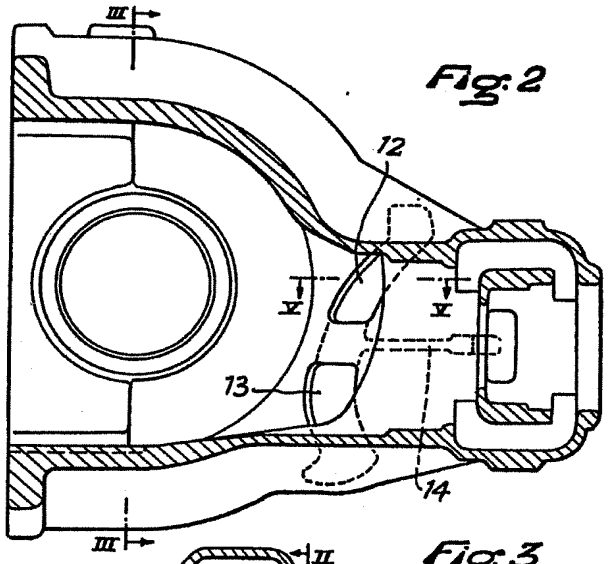

Fig: 3

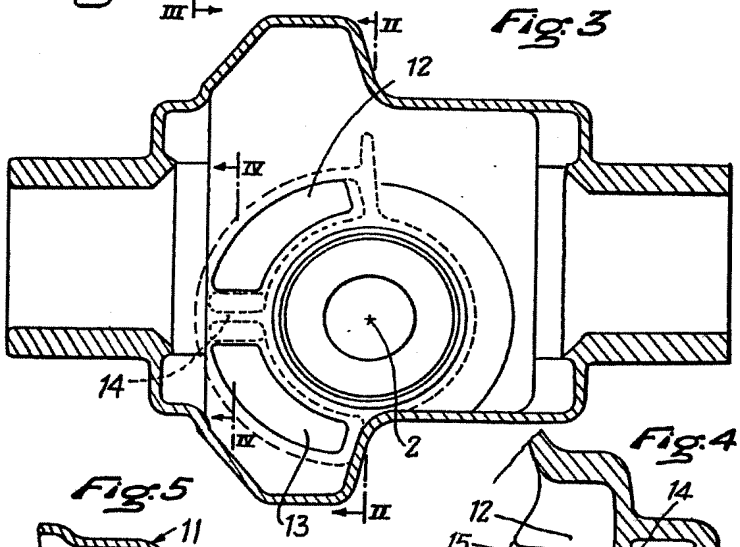

Fig: 4

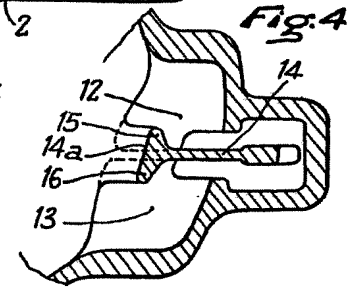

Fig: 5